Chapter 2

Affected Environment

Contents

Introduction to Chapter 2

Key Terms Used in This Section

Basin — In this EIS, refers to the Interior Columbia Basin Ecosystem Management Project area, including the project area (Forest Service- and BLM- administered lands) and other ownerships, as difined in the *Scientific Assessment*. (Quigley and Arbelbide 1997).

Current period —The current period depicts general conditions in the project area representative of the period between 1985 and 1995, approximately.

Ecological Integrity — In general, ecological integrity refers to the degree to which all ecological components and their interactions are represented and functioning; the quality of being complete; a sense of wholeness. Areas of high integrity would represent areas where ecological functions and processes are better represented and functioning than areas rated as low integrity.

Ecological Reporting Unit (ERU)— A geographic mapping unit developed by the Science Integration Team (currently referred to as the Science Advisory Group) to report information on the description of biophysical environments, the characterization of ecological processes, the discussion of past management activities and their effects, and the identification of landscape management opportunities.

Historical range of variability (HRV) —The natural fluctuation of ecological and physical processes and functions that would have occured in an ecosystem during a specified previous period. In this EIS, refers to the range of conditions that are likely to have occurred for several centuries prior to settlement of the project area by people of European descent (approximately the mid 1800s), which would have varied within certain limits over time. HRV is discussed only as a reference point, to establish a baseline set of conditions for which sufficient scientific or historical information is available to enable comparison to current conditions.

Historical period —The historical period is reflected by information recorded during the early decades of Euro-american settlement of the basin (approximately the mid 1800s), prior to major changes caused by this settlement and by subsequent patterns of use.

Hydrologic Unit Code (HUC) —A hierarchical coding system developed by the U.S. Geological Service to identify geographic boundaries of watersheds of various sizes.

Project Area — In this EIS, refers to the entire Interior Columbia Basin Ecosystem Management Project area, encompassing both the "Eastside" and "Upper Columbia River Basin" planning areas as described in the Draft EISs, *minus* the areas removed from the decision space (Nevada, Utah, Wyoming, and the area that overlaps the Northwest Forest Plan) as described in Chapter 1.

Resource Advisory Council/Provincial Advisory Committee (RAC/PAC) Area — Resource Advisory Councils (RACs) were established by the BLM to provide a forum for non-federal partners to engage in discussion with BLM managers regarding management of federal lands. Provincial Advisory Committees (PACs) were established by the Forest Service, under the Northwest Forest Plan, to provide a forum for non-federal groups and individuals to advise and make recommendations to federal land managers regarding management of federal lands. There are 12 RAC or PAC areas in the project area. Each area has its own advisory council or committee.

Subbasin —A drainage area of approximately 800,000 to 1,000,000 acres, equivalent to a 4th-field Hydrologic Unit Code (HUC). Hierarchically, subwatersheds (6th-field HUC) are contained within a watershed (5th-field HUC), which in turn is contained within a subbasin (4th-field HUC). This concept is shown graphically in Figure 2-1.

Introduction

This Introduction describes the purpose and organization of Chapter 2 and how information was gathered and presented. In addition, it provides discussion of basic ecosystem concepts for a better understanding of the rest of the chapter and the rest of the EIS. These concepts include historical range of variability, ecological processes and functions, and ecological integrity and ecosystem health. Finally, the Introduction closes with a discussion of positive ecological trends that have occurred over the past 10 to 20 years on Forest Service- and BLM-administered lands.

Purpose and Organization of Chapter 2

The purpose of this chapter is to describe the existing environment, including conditions and trends, that will be addressed by management alternatives in Chapter 3 and Chapter 4. Descriptions focus on lands administered by the Forest Service or Bureau of Land Management (BLM) in the project area.

Aquatic, riparian, wetland, and upland habitats and their related species of plants and animals function in a connected and integrated manner. However, discussion of these systems is made easier by separating the various components. Accordingly, this chapter is organized by:

Landscape Dynamics Component

- *Physical Setting:* Geology, soils, hydrology
- *Upland Terrestrial Vegetation:* Potential vegetation groups, terrestrial communities, and terrestrial source habitats

Terrestrial Species Component

- *Terrestrial Species:* Plants; animals; source habitats for terrestrial vertebrates; special category species; and hunting, viewing, collecting considerations

Aquatic–Riparian -Hydrologic Component

- *Aquatic–Riparian–Water Quality:* Aquatic habitats, riparian areas and wetlands, water quality, fish and other aquatic species

Social–Economic–Tribal Component

- *Social–Economic*: Social / economic / political systems, population, urban-rural-wildland interface, land ownership and major uses, economic and social characteristics and relationships, overview of employment, communities, attitudes / beliefs / values.
- *Federal Trust Responsibility and Tribal Rights and Interests:* Cultures, changes in uses of and relationships with the land, tribal governments, current federal agency relations, American Indian issues.

Chapter 2 focuses on those portions of the environment that the alternatives (Chapter 3) address and that are administered by the BLM or the Forest Service in the project area. Local conditions may actually be either healthier or more degraded than are described here because those local conditions are not discernible at the broader or regional scale addressed by this EIS.

Information about the landscape, terrestrial, aquatic, and social-economic settings is provided to:

- Focus on broad-scale features, conditions, and trends, in keeping with the refined focus of the project as discussed in Chapters 1 and 3;
- Show specific changes from historical to current times within the project area;
- Describe more fully the statement of needs explained in Chapter 1; and
- Lay the foundation for understanding and evaluating the alternatives discussed in Chapters 3 and 4.

A Summary of Conditions and Trends (from the historical to current period) is provided for each section.

Where appropriate, information is organized by potential vegetation group (PVG) and described by ecological reporting unit (ERU) or Resource Advisory Council / Provincial Advisory Committee (RAC / PAC) area, where data is summarized for those areas. ERUs and RAC / PACs are explained below.

A detailed description of the project area is provided in the *Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin and Portions of the Klamath and Great Basins* (Quigley, Haynes, and Graham 1996, hereinafter referred to as the *Integrated Assessment*) and *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins* (Quigley and Arbelbide 1997; hereinafter referred to as the *Assessment of Ecosystem Components, or AEC*). In combination, these two documents are referred to as the *Scientific Assessment*.

The *Scientific Assessment* characterizes the entire project area, regardless of ownership, to set a context within which individual BLM or Forest Service administrative units can plan and conduct ecosystem-based management. Findings in the *Scientific Assessment* are best used to understand trends on the overall landscape. In comparison, Chapter 2 of the Supplemental Draft EIS, which is based on the *Scientific Assessment,* focuses on those portions of the environment that the alternatives (Chapter 3) address and that are administered by the BLM or the Forest Service in the project area. These descriptions are limited to the significant *broad-scale* conditions and trends of most concern to the public, the Forest Service, or the BLM. Descriptions of *site-specific* conditions can generally be found in current land use plans available at local Forest Service or BLM offices. Readers should be aware that local conditions may actually be either healthier or more degraded than are described here because those local conditions are not discernible at the broader or regional scale addressed by this EIS.

Changes from Draft EISs

Chapter 2 Overall

Refined Broad-scale Focus

While the organization closely parallels that in the Draft EISs, the content in some places has been changed to reflect the refined focus of the project as described in Chapters 1 and 3, based either on new information from science, comments on the Draft EISs, and/or discussions with tribal and interagency partners. This refined focus addresses a limited number of issues which must be resolved at the basin level. Therefore, some Chapter 2 discussions from the Draft EISs have been dropped if they were determined to be more fine-scale than would be appropriate for the broad-scale focus of this project. All information has been updated and revised as appropriate.

Landscape Dynamics Component

The Physical Setting portion of the Landscape Dynamics Component includes discussion of hydrologic processes and functions, which was located in the Aquatic-Riparian section of the Draft EISs. Water Quality is discussed under Aquatic-Riparian Hydrologic in the Supplement to better link the topic to aquatic habitats.

Terrestrial Species Component

Chapter 2 of the Draft EISs presented information on terrestrial species by potential vegetation group. The Supplemental Draft EIS provides instead a separate Terrestrial Species section, with information on terrestrial vertebrates organized primarily by Terrestrial Family from *Source Habitats for Terrestrial Vertebrates of Focus on the Interior Columbia Basin* (Wisdom et al. in press). Additional information on plants is provided. See the Terrestrial Species section for details.

Aquatic–Riparian Hydrologic Component

The Draft EISs included detailed discussion of ocean-type chinook salmon and Snake River sockeye salmon. The aquatic Science Advisory Group did not include these species in their detailed evaluation because virtually the entire spawning and rearing habitat for these species occurs on non-federal land. Therefore, ocean-type chinook salmon and Snake River sockeye salmon are not discussed in detail in this Supplemental Draft EIS.

Social–Economic–Tribal Component

The Draft EIS sections on Human Uses and American Indians have been combined into one Social–Economic–Tribal Component, to better reflect these closely interrelated issues. The Social–Economic portion has been substantially revised to better display social and economic conditions, trends, and effects relating to counties and communities and incorporate information from *Economic and Social Characteristics of Communities in the Interior Columbia Basin* (ICBEMP1998). Portions of the UCRB Draft EIS (Human Uses Overview) and Eastside Draft EIS (Snapshots in Time) are combined and provided on the pages immediately preceding Chapter 1.

How Information was Gathered and Presented

Hydrologic Unit Codes

For the purposes of analyzing and summarizing much of the information on landforms and on terrestrial and aquatic ecosystems collected for the *Scientific Assessment*, the Science Integration Team identified watersheds and watershed boundaries. The identification system used to describe these watersheds follows the numeric coding system known as Hydrologic Unit Codes (HUCs) used by the U.S. Geological Survey (Figure 2-1 and Table 2-1a).

Boundaries and their numeric codes for larger watersheds (“regions”, “subregions”, “basins”, and “subbasins”, respectively coded as 1st- through 4th-field HUCs) were adopted without change from those identified by the U.S. Geological Survey. There are 160 4th-field HUCs in the interior Columbia Basin. Smaller units (“watersheds” and “subwatersheds” or 5th- and 6th-field HUCs) were identified as part of the ICBEMP process. Within the project area there are approximately 7,000 subwatersheds, or 6th- field HUCs, which are approximately 20,000 acres each. These subwatersheds were the basic characterization unit for the *Scientific Assessment* and the basic mapping unit for identifying Ecological Reporting Units. The subwatersheds mapped as part of this project do not necessarily match those that have been previously mapped by administrative units of the Forest Service or BLM.

Ecological Reporting Units

In the Draft EISs and the *Scientific Assesment*, the project area was divided into 13 geographic areas called Ecological Reporting Units (ERUs) to provide a consistent way for each Science Intergration Team staff group to report their findings. The ERUs were developed specifically for consistent reporting purposes, not for analysis or implementation. They correspond to the boundaries of subwatersheds (defined above). The 13 ERUs were identified by a process that integrated human uses and terrestrial and aquatic ecosystem data. They were the basis for reporting information on the following: (1) description of biophysical environments, (2) characterization of ecological processes, (3) discussion of past management activities and their effects, and (4) identification of landscape management opportunities.

Resource Advisory Council/ Provincial Advisory Committee (RAC/PAC) Areas

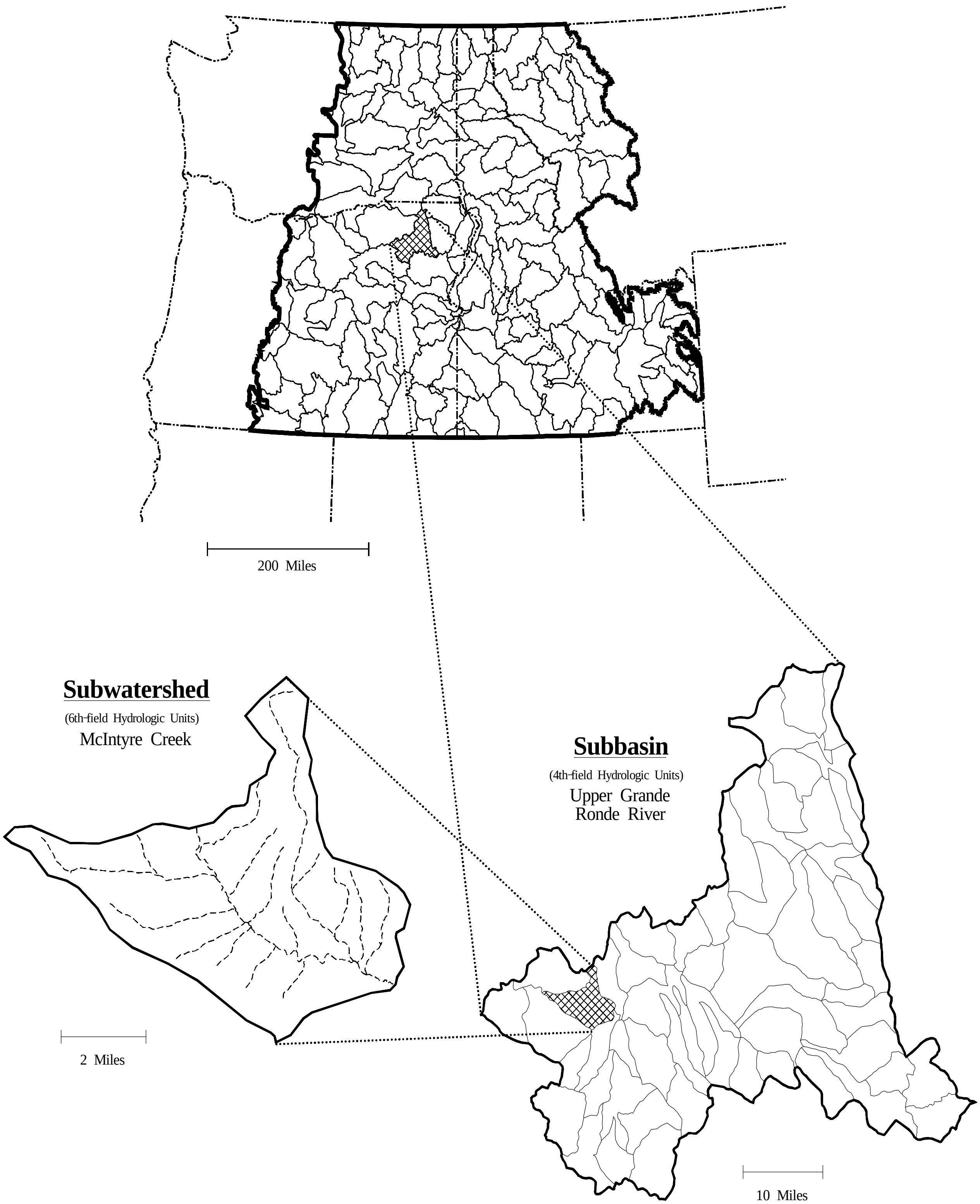
For the Supplemental Draft EIS, the project area was further described by 12 existing Resource Advisory Council (RAC) areas or Provincial Advisory Committee (PAC) areas, referred to as RAC/PAC areas. Each area has its own advisory council or committee. Resource Advisory Councils (RACs) were established by the BLM to provide a forum for non-federal partners to engage in discussion with BLM managers regarding management of federal lands. Provincial Advisory Committees (PACs) were established by the Forest Service, under the Northwest Forest Plan, to provide a forum for non-federal groups and individu-

Ecosystem Principles

The Science Integration Team brought forward four ecosystem management principles in the *Framework for Ecosystem Management in the Interior Columbia Basin and Portions of the Klamath and Great Basins* (Haynes, Graham, and Quigley 1996). The EIS was developed to be consistent with these principles:

1. Ecosystems are dynamic, evolutionary, and resilient.
2. Ecosystems can be viewed spatially (on the ground) and temporally (through time) hierarchically within organizational levels.
3. Ecosystems have biophysical, economic, and social limits.
4. Ecosystem patterns and processes are not completely predictable.

Figure 2-1. Hydrologic Hierarchy



LEGEND

Streams	Subbasin Borders	McIntyre Creek and Upper Grande Ronde River HUC Borders
Subwatershed Borders	State Borders	Supplemental Draft EIS Area Border

Table 2-1a. Hierarchy of Watersheds.

Hierarchy Team	Hydrologic Unit Code (HUC)[1]	Number in Project Area[2]	Example Watershed	Size of Example (Acres)
Region	1st-field	3	Columbia River	165,760,000[3]
Subregion	2nd-field	10	Lower Snake River	22,400,000
River Basin	3rd-field	16	Salmon River	8,960,000
Subbasin	4th-field	160	Upper Grande Ronde River	1,050,000
Watershed	5th-field	2,356	McIntyre Creek	50,000
Subwatershed	6th-field	6,788	Profile Creek	12,600

[1] 1st-field thru 4th-field HUCs were formally designated by the U.S. Geological Survey. 5th-field and 6th-field HUCs were designated for the project area (Jensen et al. 1997).
[2] Includes all watersheds that are entirely or partly within the project area.
[3] The area of the Columbia River watershed includes the entire basin, including portions outside the project area west of the crest of the Cascade Range and in Canada. Figures rounded to nearest 10,000 acres.

als to advise and make recommendations to federal land managers regarding management of federal lands.

As previously stated, the ERUs were used primarily as *reporting units*. Based on public comment received on the Draft EISs, it was felt that the already established RAC and PAC areas would be more practical as *implementation units*; therefore, they are introduced in this EIS and information is summarized by these areas whenever possible. However, not all information is summarized by RAC / PAC area, and not all socio-economic or ecological processes conform to RAC / PAC boundaries. Where either of these situations occur, descriptions are within the appropriate or available context. The boundaries of RAC / PAC areas and ERUs are similar, but not identical. Both boundaries are shown on Map 2-1; a crosswalk is shown in Table 2-1b.

Counties and BEA Regions

A comparison of economic, social, and political systems provides the proper context for agency decisions regarding economic and social objectives. People-oriented policies of the Forest Service and BLM historically have had a local focus, emphasizing the well-being of individuals, user groups, and communities that are economically or socially connected to agency lands. For this EIS, the primary scale of interest is the basin. Information on current conditions and trends is presented at two main levels.

The broadest level at which recent social and economic conditions are discussed is for the interior Columbia River Basin as a whole. A second level of analysis focuses on counties or communities grouped in terms of their perceived character (timber; recreation, tourism and retirement; ranching; mining; and, other) and / or based on their trading area. When using county-level data in this analysis, the region is defined as the 92 counties into which any part of the project area falls, although for some of these counties the land area and economic activity that occur within the basin are minor. Market and non-market economic phenomena are discussed at the national level when necessary to set context. (See Map 2-2.)

To understand socio-economic processes, the Science Team defined two sets of subregions within the basin: one set to examine regional economies, the other to examine the societal value of what might be supplied by BLM- and Forest Service-administered lands in various ecosystems. When discussing the regional economy, they used nine economic regions, modified from a recent publication by the Bureau of Economic Analysis (BEA). The BEA defined functional economic units by identifying economic nodes and the surrounding counties economically related to them. Work commuting patterns are the primary factor used to determine economic regions. The goal is to include, as far as possible, both the place-of-work and place-of-residence of the labor force (see Map 2-24 later in this chapter).

The Supplemental Draft EIS uses RAC / PAC areas as the base level for display of estimated biophysical and socio-economic effects. Some economic and social conditions are also described for counties, and to the extent possible, for communities or groups of communities, to provide some basis for evaluating probable effects of management alternatives at a more local level. However, the broad-scale level of analysis and estimation of effects, as well as data limitations, make it impossible to provide specific effects for each community in this planning process (see Haynes and Horne [1997] and McGinnis and Christensen [1996]).

Map 2-1. RAC/PAC Areas and Ecological Reporting Units.

Table 2-1b. Crosswalk Between the Ecological Reporting Units and the Resource Advisory Council/Provincial Advisory Committee Areas.

Ecological Reporting Units (ERUs)	Resource Advisory Council/Provincial Advisory Committee (RAC/PAC) Areas
Blue Mountains	John Day-Snake RAC Southeastern Oregon RAC
Central Idaho Mountains	Upper Columbia/ Salmon-Clearwater RAC Regions 1 and 4 Lower Snake River RAC
Columbia Plateau	Eastern Washington RAC Yakima PAC Deschutes PAC Upper Columbia/ Salmon-Clearwater RAC Region 1 John Day-Snake RAC
Lower Clark Fork	Butte RAC Upper Columbia/ Salmon-Clearwater RAC Region 1
Northern Cascades	Yakima PAC Eastern Washington- Cascades PAC Eastern Washington RAC
Northern Glaciated Mountains	Butte RAC Upper Columbia/ Salmon-Clearwater RAC Region 1 Eastern Washington RAC
Northern Great Basin	Southeastern Oregon RAC
Owyhee Uplands	Upper Snake RAC Lower Snake River RAC Southeastern Oregon RAC
Snake Headwaters	Upper Snake RAC
Southern Cascades	Yakima PAC Deschutes PAC
Upper Clark Fork	Butte RAC
Upper Klamath	Southeastern Oregon RAC Klamath PAC
Upper Snake	Upper Snake RAC

Map 2-2. Ecological Reporting Units and Counties.

Historical Range of Variability

The historical period of pre-European settlement was selected for this EIS only as a reference point from which to compare current conditions.

Throughout this chapter, reference is made to "historical conditions" or the "historical range of variability." "Historical" in this EIS is intended to represent ecological conditions and processes that are likely to have occurred prior to settlement of the project area by people of European descent (approximately the mid 1800s). Historical conditions and processes are portrayed in this EIS for a number of variables such as forest and range vegetation types, compositions, and structures; fish and wildlife habitats and populations; and fire regimes. These historical conditions would have varied over time within an estimated range. Historical conditions referenced in this EIS generally represent some point within the historical range of variability (HRV) (Figure 2-2).

The historical period of pre-European settlement was selected for this EIS **only as a reference point**, to establish a baseline set of ecological conditions for which sufficient scientific or historical information is available to enable comparison to current conditions.

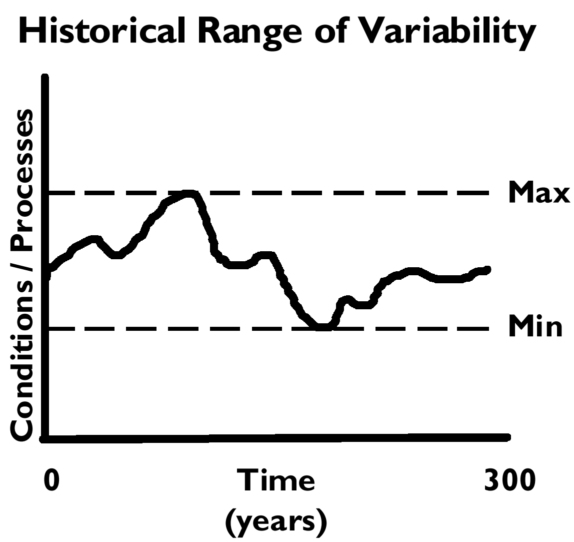


Figure 2-2. Historical Range of Variability.
Conditions naturally vary over time, generally within a certain range. Scientists have estimated what that range may have been in the past. Conditions higher than the estimated maximum or lower than the estimated minimum would be considered to be outside the 'historical range of variability' and may be an indication of a loss of ecological integrity and ecosystem health.

Such a comparison is valuable to understand how ecological processes and functions operated with human uses, but prior to high human populations and contemporary technology. This can provide clues and blueprints for designing management strategies that maintain the ecological integrity of those processes under future management strategies. It is recognized that in many cases, it is neither desired nor feasible to return to actual historical conditions. For example, historically there were no paved roads or buildings in the project area; obviously it is neither feasible nor desirable to return to that condition.

Ecological Integrity and Ecosystem Health

One of the underlying needs for preparing this EIS is for "restoration and maintenance of long-term ecosystem health and ecological integrity on Forest Service- and BLM-administered lands" (see Chapter 1). Integrity generally means the quality or state of wholeness or being complete and unimpaired. The Science Team used the term "ecological integrity" as a measure of the presence of physical and biological processes, patterns, and functions. The concept of ecological integrity helps to answer many questions, including:

1. Where are the areas of high or low ecological integrity across the project area?
2. Where are the opportunities to improve integrity?
3. What risks to integrity exist from management actions?

Because there are no direct measures of integrity, "proxies" or substitutes were selected to represent the broad array of functions, processes, and conditions. For example, the proportion of the area where fire severity and frequency changed between historical and current periods was used as one of the proxies to represent such elements as consistency of tree stocking levels with long-term disturbances and

Broad, Mid, and Fine Scale

Ecological processes and structures can be viewed at multiple scales, depending on the feature or process to be observed or the outcome that is desired. Landscape ecology often uses terms like broad, mid, and fine temporal (time) and spatial (geographic) scale. The *Scientific Assessment* and interior Columbia Basin EISs also use these terms. Temporal and spatial scale are often linked. In the EIS, short term for the broad scale is considered to be 10 years and long term is considered to be 100 years (unless otherwise specified). In the *Scientific Assessment,* the dynamics of the historical range of variability (HRV) were assessed over a 400-year time period to learn how ecosystems changed through time with succession and disturbance. This was helpful in determining management direction to modify ecosystems into the future.

The three levels of geographic scale (broad, mid, and fine) were analyzed in the *Scientific Assessment* and addressed in the EIS:

Broad scale - a large, regional area, such as a river basin and typically a multi-state area. A broad-scale analysis can identify dominant characteristics and trends across a large area (such as the interior Columbia River basin). Much of the analysis of the interior Columbia River basin was at a broad scale where 1 inch on a map ranged from 1.5 to 31.5 miles on the ground (1:100,000 to 1:2,000,000). These are maps in which the size of a pixel (the smallest polygon mapped) is 1 square kilometer (250 acres) or larger. At this scale, the distance from Seattle to Spokane would be obvious, but streets in Spokane would be too small to see (similar to a state highway map).

Mid scale - a subregional area, such as a group of contiguous subbasins. The *Scientific Assessment* addressed many aspects of BLM- and Forest Service-administered lands at the mid scale (where 1 inch on a map represented 0.4 to 1.5 miles [1:24,000 to 1:100,000] on the ground). For example, vegetation types, insect and disease susceptibility, riparian conditions, potential wildfire risk, and roads were mapped at this mid scale for 334 subwatersheds (a statistical sample size). This information was then correlated with broad-scale data and extrapolated across the project area. The pixel size of a mid-scale map is 4 hectares (10 acres) or larger. At this scale, the relation between Division Street in Spokane and other streets in the same city would be visible, but the distance from Spokane to Seattle (the broad-scale perspective) would be lost (similar to a city map).

Fine scale - a single landscape, such as a watershed or subwatershed. The *Scientific Assessment* addressed many aspects of BLM- and Forest Service-administered lands at the fine scale (where 1 inch on a map represents 0.4 miles [1:24,000] or less). For example, variations in forest snags and fuels was assessed through analysis of plot data, while specific fisheries stream data was used to assess trends of fish habitat and populations. At this scale, the location of a particular desk in a particular building would be visible, but the location of the building in a city or the city in a state would be lost (similar to a blueprint or a house plan).

As scale moves from coarse or broad to fine, the amount of visible detail increases but the relationships among larger components become less visible. While fine-scale maps and data might appear to be most desirable, there are tradeoffs. Broad-scale maps and data help to understand broad-scale relations. Fine-scale data are difficult and expensive to acquire and the amount of detail may mask larger relations or trends.

In reality, scales are continuous, much like looking through a camera lens while zooming in and out to focus on the desired subject or composition of the photo. Humans use pictures or maps at different scales to help achieve different objectives. For example, a state highway map would be used to find a route across the state, while a city map would be used to find a hotel or a park.

Attempting to focus on only one scale can cause errors in decisions, much like what could happen if a city map is used to find a route across a state. In general the better the next coarser scale is understood, the more context is available to assure goals are met; and the better the next finer scale is understood, the better the understanding of the function of ecosystem components. For example, at a finer scale, the function of snags as habitat can be discerned, while the areas where snag levels are decreasing can be determined at a larger scale; both scales are important. If the broad-scale direction from this EIS says to increase snag levels where their numbers are below the historical range of variability, then the best options for restoring the desired pattern of snags could be determined through mid-scale planning (such as a land use plan), and the specific numbers, species, sizes, and recruitment patterns of snags could be determined through finer scale planning (such as an environmental assessment).

the effect of wildfire on the composition and patterns of forest types. Proxies such as these were used to estimate current conditions and project trends in integrity into the future.

Ecosystem "health" encompasses both ecological integrity and what people want to do with the land.

Ecological integrity is difficult to measure directly for several reasons. First, it is unknown exactly what is in any particular ecosystem, because of the size, complexity, and ambiguous nature of most of its parts and processes. Second, the structure, function, and composition of ecosystems are always changing. Third, ecosystem changes are only partially predictable; they respond to a combination of internal processes and outside influences. And finally, the boundaries people put on ecosystems are artificial lines, making it hard to know when an entire system or a part of one or more systems are being studied.

Therefore, integrity was estimated in a relative sense. Where forest, rangeland, and aquatic system processes and functions were present and operating best in the project area, integrity was rated higher than areas where these functions and processes were not operating. These estimates represented such elements as water cycling, energy flow, nutrient cycling, and maintenance of viable populations of plants and animals.

In general, for the purposes of the Interior Columbia Basin Ecosystem Management Project, aquatic and terrestrial systems with "high integrity" were defined as those that consist of a mosaic of plant and animal communities, and have well connected, high quality habitats that support a diverse assemblage of native and desired non-native species that adapt to a variable environment. Measures were developed by the Science Integration Team using direct and indirect variables to indicate how much various elements have departed from historical conditions. For the purposes of this analysis, "high departure" signifies that an area is significantly different than the condition expected for its biophysical environment, and roughly indicates "low integrity." In measuring integrity, the Science Team looked primarily at landscape features and fish communities, because they encompass most of the significant planning issues (see Chapter 1). The emphasis on landscape features and fish also provides a geographically explicit, ecologically driven context for discussing management alternatives.

The integrity of ecosystems encompasses both biophysical and social components because any discussion of ecosystems is also inherently a discussion about the way humans value and use the land. The concept of ecological integrity, as described above, is part of the broader concept of ecosystem health used in the EIS. The EIS Team used the term "health" to refer to the capacity of forest, rangeland, and aquatic ecosystems to persist and perform as expected or desired in a particular area. Varying degrees of "wholeness" or integrity may be needed to enable a particular place to be used in the manner desired by society both now and in the future. Some uses will demand different mixes of fire regimes, water cycles, and energy flow resulting in differences in productivity, resiliency, and renewability. The mix of these elements of "integrity" that would allow achievement of a particular management objective in a particular place will define what is "healthy" for that area.

The integrity of ecosystems encompasses both biophysical and social elements, because any discussion of ecosystems is also a discussion of the way humans value and use the land.

For example, in some areas, such as near developed recreation sites or areas with scattered homes, restricting the presence of fire as a process may be important to achieving the broad goals for an area. The result may mean lower ecological integrity than if the fire regimes were allowed to operate fully, but might be judged as

Ecological Processes and Functions

The terms "ecological processes" and "ecological functions" in general refer to the flow and cycling of energy, materials, and organisms in an ecosystem. The nitrogen, carbon, and hydrologic cycles, and energy flow in terrestrial systems are among the ecological processes discussed in other sections of this chapter. Following are some additional functions and processes that are important to ecosystem health

- **Water capture.** Sites are able to effectively capture water when they maintain high infiltration rates and a high capacity for surface capture and storage of water.
- **Water storage.** Water is stored well when soil is stable and able to retain moisture; and when soil organic matter, well dispersed litter, and plant canopies that reduce evaporation losses from the soil are maintained.
- **Water cycling.** Water is cycled more effectively when it is released from a site in such a way that (1) low amounts of sediment are transported in runoff, (2) there is sufficient subsurface flow of water, and (3) plants and animals are able to use water for physiological functions.
- **Nutrient and energy cycling.** In healthy ecosystems, nutrients cycle and energy flows through a system in a pattern that is appropriate for the geoclimatic setting.
- **Energy capture (photosynthesis).** Plants are able to store resources necessary for drought survival, overwintering, and new growth initiation. They retain canopy cover, litter, and root systems sufficient to protect them from death or loss of vigor during stress periods.
- **Adaptation.** Plants and animals have evolved and adapted to conditions on the landscape. Healthy ecosystems have sufficient food, cover, and other habitat attributes to maintain sufficient populations for reproduction, genetic interactions, and long-term survival.

healthy from an ecosystem perspective because it is meeting the expectations of society. Another example might be managing to restrict riparian flooding, which from an ecological frame of reference would reflect lower integrity than if the flooding were to be present, yet this area might contribute to the overall ecosystem health because it is favorably contributing to society's goals.

Ecosystem health includes not only how "intact" the ecological processes and functions need to be compared to their capabilities to accomplish current and future management objectives, but it also includes measures of social and economic resiliency, management philosophies and goals, and other human factors.

Positive Ecological Trends

The nature of the Interior Columbia Basin Ecosystem Management Project has been to focus on what is going wrong with ecosystems, then to determine what changes to management activities are necessary to improve ecological conditions. Much of the discussion in Chapter 2 emphasizes these needed changes.

Although some ecosystems have declined in health, many ecological conditions and trends have improved in the past two decades. Some areas where improvement has been achieved over the past 10 to 20 years on Forest Service- or BLM-administered lands are as follows:

- **Soil productivity—**Management practices in use today reflect improved understanding of the sensitivity of soils to various treatments, especially at the fine scale.
- **Road construction and management**—Management practices in use today reflect improved understanding of negative effects of roads. New road construction and maintenance of permanent roads occur with greater understanding of drainage, erosion potential, fish passage concerns, slumpage problems, and other hazards. Much remains to address in the future, especially with secondary and closed roads.

Although the condition of some ecosystems has declined, many ecological conditions and trends have improved in the past two decades.

- **Range management and range conditions**—The current condition of rangelands appears to be the best it has been since the turn of the century; however, this assessment is not agreed upon by all (National Research Council 1994). The declining condition of riparian areas has, for the most part, been slowed or stopped, and managers are acquiring a better understanding of how to alleviate negative effects of management practices on riparian areas. The BLM and Forest Service are placing a heavy emphasis on proper management of riparian areas in land use plans and on the ground.
- **High-profile listed species**—Many of these species are protected. The grizzly bear, bald eagle, and some others (see Appendix 6) have recovery plans that are in place and are being implemented. Attention has expanded to also include other species that traditionally have generated less public appeal.
- **Landscape approach recognition**—Overall, land managers within the project area have recognized the need for a landscape approach to management of resources. A landscape approach is a broader, more integrated look at resource management than has been traditionally done in the past. On-the-ground managers appear ready and willing to accept the change, and in fact many managers are already using this approach to resource management.
- **Prescribed fire techniques**—Techniques available for prescribed fire within the project area have improved. A variety of conditions can now be achieved from the application of prescribed fire using different treatments.
- **Forest management approaches**—The past 10 years have seen substantial change in the treatments applied to forested areas, both in harvest techniques and silvicultural treatments. Managers have a wider array of options with more benign effects to select as treatments.
- **Recognition of exotic species and their influence**—The relatively recent and rapid expansion of exotic species and their impact on ecosystems are receiving more attention by resource managers, who recognize that preventing the spread and reducing the extent of exotics is necessary. Scientists are testing and developing combinations of control methods that are promising for control of exotic plant species.
- **Interaction with a wide array of the public**—Recent trends have been for managers to have more open discussions earlier in planning processes with a wider, more varied group of people, organizations, and agencies.

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